SEASONAL VARIATION IN THE MACROPHYTES OF TWO PONDS, RATHESHWAR AND TARAPUR, IN CENTRAL GUJARAT[1]

J.I. Nirmal Kumar[2], Rita Nirmal and B.C. Rana[3]

The periodic fluctuations of aquatic vegetation were studied in two ponds, Ratheshwar and Tarapur. The enrichment of three categories of 15 plant species were recognized for Ratheshwar, where the pond water appeared fresh and clean. Only five aquatic plants were observed in Tarapur pond, where the pond water had been polluted by domestic sewage and agricultural fertilizers. The indicator function of aquatic macrophytes is discussed.

Introduction

Macrophytes are widely distributed in tropical and subtropical aquatic ecosystems. Concomitant with fertility rate of our inland water bodies, macrophytic infestation has reached an alarming state. The majority of water bodies, particularly shallow water bodies, are partly or wholly covered by one or more macrophytes (Varshney and Rzoska 1973). These macrophytes play an important role in energy input, nutrient budget and recycling of nutrients in the water bodies (Howard-Williams and Junk 1977, Mickle and Wetzel 1978, Rana and Nirmal Kumar 1988). Macrophytes are pollution abatement and pollution indicators of water bodies (Shashikant 1978, Kaul *et al.* 1980). Production studies of macrophytes in India are meagre (Kaul 1977, Pandya and Kaul 1976, Sharma and Gopal 1977, Gopal and Sharma 1978, Adoni and Yadav 1985).

Very few attempts have been made to study or survey the occurrence of aquatic vegetation in Gujarat (Mirashi 1957, Chavan and Sabnis 1961, Inamdar 1968). An attempt has been made in the present investigation with a view to study the seasonal variation and make some observations on vegetational characters of certain aquatic plants in two ponds of central Gujarat.

[1]Accepted September 1990.

[2]P. G. Department of Botany, Jai-Hind College, Dhule 424 002, Maharahtra.

[3]Department of Biosciences, Sardar Patel University, Vallabh Vidyanagar, Gujarat 388 120.

Study Area

Ratheshwar pond: The pond is situated in Periage, about 45 km south-west of Anand in Matar taluka of Kheda district. It is 33 hectares in area and has a depth of about 4-5 m. The main water source is a fresh water channel of Nav Talav. The water is used for drinking, washing and household purposes by the surrounding villagers. Three stations were marked from where plants were collected and checked during the present investigation: (1) at the outflow of water, (2) where the organic pollution and human activities are more, and (3) at the inflow of the water to the pond, where contamination is less than at the other two stations.

Tarapur pond: The pond is situated in Tarapur village, about 35 km south-west of Anand in Khambhat taluka, Kheda district. The water surface is about 8-9 hectares in area and has a depth of 2.5-3.5 m. Domestic sewage, agricultural fertilizers and human activities have polluted the pond.

Material and Methods

Aquatic macrophytes were collected with the help of metallic hook and string from both ponds at the above mentioned stations, kept in polythene bags and brought immediately to the laboratory, where they were washed under tap water. The plants were treated with 10% silver sulphate (in 90% ethanol) for one minute to prevent fungal and bacterial infection. The plants were dried with blotting paper and herbarium sheets were made and identified with the

TABLE 1

SEASONAL VARIATION OF AQUATIC MACROPHYTES IN RATHESHWAR AND TARAPUR PONDS

Ponds	Macrophyte species	Habitat	Months											
			June, 1988	July	August	September	October	November	December	January, 1989	February	March	April	May
Ratheshwar	*Typha angustata*	Marshy	+	+	+	+	+	+	+	+	+	+	+	+
	Echinochloa colonum	,,	+	+	+	+	+	+	+	+	+	+	+	+
	Marsilea quadrifolia	,,	+	+	+	+	+	+	+	+	+	+	+	+
	Ipomoea aquatica	,,	+	+	+	+	+	+	+	+	+	+	+	+
	Fimbristylis ferruginea	,,	+	+	+	+	+	+	+	+	+	+	+	+
	Cyperus alopecuroides	,,	+	+	+	+	+	+	+	+	+	+	+	+
	Nymphoides cristata	Floating	–	–	–	–	+	+	+	+	+	+	–	–
	Potamogeton pectinatus	Sub-merged	+	+	+	+	+	+	+	+	+	+	+	+
	P. nodosus	,,	–	–	–	+	+	+	+	+	+	+	+	–
	P. crispus	,,	–	–	–	–	–	+	+	+	+	+	–	–
	Hydrilla verticillata	,,	+	+	+	+	+	+	+	+	+	+	+	+
	Najas minor	,,	+	+	+	+	+	+	+	+	+	+	+	+
	Vallisneria spiralis	,,	–	–	–	–	–	+	+	+	+	+	–	–
	Ottelia alismoides	,,	–	–	–	–	+	+	+	+	+	–	–	–
	Chara sp.	,,	–	–	–	–	+	+	+	+	+	–	–	–
Tarapur	*Echinochloa colonum*	Marshy	+	+	+	+	+	+	+	+	+	+	+	+
	Ipomoea aquatica	,,	+	+	+	+	+	+	+	+	+	+	+	+
	Eichhornia crassipes	Floating	+	+	+	+	+	+	+	+	+	+	+	+
	Hydrilla verticillata	Sub-merged	–	–	–	–	–	+	+	+	+	–	–	–
	Ceratophyllum demersum	,,	–	–	+	+	+	+	+	+	–	–	–	–

+=present, –=absent

help of published literature. The herbarium sheets are preserved in the Biosciences Department, Sardar Patel University. The seasonal variation of aquatic vegetation was noted and visual assessment of macrophytes was done during the study period at monthly intervals, and a few observations of aquatic vegetation characters were registered.

RESULTS AND DISCUSSION

Aquatic macrophytes can be grouped into three categories on the basis of their habitat. The name and periodic variations of macrophytes in Ratheshwar and Tarapur ponds are given in Table 1. Among the marshy community *Typha angustata, Echinochloa colonum* and *Marsilea quadrifolia* dominated, while *Ipomoea aquatica* and *Fimbristylis ferruginea* co-dominated. *Cyperus alopecuroides* was rare..

Typha angustata was observed throughout the year, surrounding the banks of Ratheshwar pond. It flowered during April-June. This species was dominant at Station 3 followed by Stations 2 and 1.

Echinochloa colonum was noticed in both ponds and dominated in Stations 1 and 3 at Ratheshwar. It flowers during July-September.

Marsilea quadrifolia was more dominant at

Station 1 than at Stations 2 and 3. This plant is perennial and has hard bean-shaped sporocarps borne on the petioles, which were observed in the months of February-April.

Ipomoea aquatica grows abundantly at all sites. The plant is perennial, flowering during October-January. It is propagated by deep underground roots and by seeds.

Fimbristylis ferruginea is a perennial plant very restricted in distribution, occurring only at Station 2. Flowers were noted during August to November.

Cyperus alopecuroides: Richer growth of this plant was observed at Station 2 than at Stations 1 and 3.

The second category includes floating plants, which were represented by *Eichhornia crassipes* and *Nymphoides cristata* in Tarapur and Ratheshwar ponds respectively.

Eichhornia crassipes was the most predominant, persistent and troublesome aquatic weed. It reproduces vegetatively by means of slender horizontal stolons. A new plant is surrounded by offspring which develop leaves, roots and send stolons in turn. Holm *et. al.* (1969) found that two parent plants were surrounded by 1200 offspring after 4 months. Such growth might be responsible for the complete coverage of the water surface of Tarapur pond in April-June. Flowering takes place in the months of March-June.

Nymphoides cristata: Solitary flowers were recorded during December-February. This plant was present at Station 3 only from October to March. Death and decay started thereafter.

The third category is the submerged group, which develops in deep and shallow waters. Among the submerged plants *Potamogeton* sp., *Hydrilla verticillata* and *Najas minor* dominated, while *Vallisneria spiralis* co-dominated and *Ottelia alismoides, Ceratophyllum demersum* and *Chara* sp. were of rare occurrence.

Potamogeton sp.: Three species, *Potamogeton pectinatus, P. nodosus* and *P. crispus* were recorded in Ratheshwar. Germination began during August-September and the plants flowered and fruited in December-March. Death and decay started during May-June, and was accelerated due to high temperature in these months; the plant completely disappeared by July.

P. pectinatus is perennial, but of rare occurrence during summer at Stations 1 and 2 of Ratheshwar. *P. nodosus* was common in Stations 1 and 2. It has pink flowers arranged on terminal spikes. *P. crispus* was observed during the winter at Station 3 only. Flowered (terminal spikes) in December-January. *Hydrilla verticillata* was noticed at all stations throughout the study period in Ratheshwar but only during winter in Tarapur pond. Germination started late in the rainy reason, flowering occurred in September and October and death and decay began from November.

Najas minor: Significant appearance of this plant during November-February and poor production in March-June was observed. The flowers are axillary, solitary, monoecious, and were observed in September-October at Stations 1 and 2.

Vallisneria spiralis: Dense growth of this species was observed only during winter (November-March) at Stations 2 and 3, while in other months it was completely absent. It has short male flowers and many female flowers, solitary, long and coiled. Flowering was during December-February.

Ottelia alismoides was seen during October-February and was absent during most of the study period. They were quite dominant during December-January, flowered in January and February and died thereafter. The plant was common at Station 3 only.

Ceratophyllum demersum: appeared during the cold months from August to January, and was completely absent during the summer. It was dominant during October-December in Tarapur pond only. Minute axillary, solitary flowers were noticed in November- December.

Chara sp. : Mass growth of this weed was a frequent feature at Station 3 of Ratheshwar during winter (October-February) and it was dominant from November to January. Species of this genus were absent from March to September. The erect stem was differentiated into nodes, internodes and shorter and longer slender branches. Reproduction was sexual, i.e. by antheridium (globule) and oogonium (nuclule); these are very complex structures with enveloping sheath and always occurred in pairs.

A few macrophytic species were registered in Tarapur pond which might be due to the high nutrient status, temperature and entry of pollutants from surrounding localities. On the other hand, aquatic vegetation was rich in Ratheshwar, which could be due to the low nutrient status, temperature of water and availability of fresh water supply through the connection of Nav Talav. However, the composition of hydrophytes varied seasonally and the number of species was greater during winter (December-February), and poor during summer (March-June) in both the ponds.

Among the marsh plants, most species are perennial, but free floating and submerged plants are restricted to post-rainy and winter seasons only. However, some of the submerged species such as *H. verticillata, P. pectinatus* and *N. minor* exist throughout the year in Ratheshwar. *E. crassipes* and *T. angustata* were the most prominent species growing in Tarapur and Ratheshwar ponds respectively. The observations in the present investigation are in accordance with those of Gopal and Sharma (1978), Adoni and Yadav (1985) in certain water bodies for aquatic weeds in northern parts of India.

The occurrence of *H. verticillata, E. colonum* and *I. aquatica* in both ponds revealed their adaptable nature to different aquatic ecosystems, and they faced no pollution threat in these waters. *E. crassipes* and *C. demersum* were present only in Tarapur pond. It also indicates that these two species can tolerate relatively high levels of pollution (Shimoda 1984, 1986). Rana *et al.* (1990) reported that the water quality, nutrients and pollution status at Tarapur pond was higher than at Ratheshwar pond. Apart from this, the rich growth of other species was restricted to Ratheshwar. This could be the result of unpolluted nature of water.

There is a difference in the aquatic vegetation at Stations 1 and 3 of Ratheshwar. Station 1 had profuse growth of *P. pectinatus, P. nodosus, N. minor; T. angustata, M. quadrifolia* and *I. aquatica,* but rarely *H. verticillata,* whereas Station 3 was dominated by *P. crispus, Chara* sp., *O. alismoides, N. cristata* and co-dominated by *V. spiralis, N. minor; P. nodosus, T. angustata* and rarely *I. aquatica, M. quadrifolia* and a few grasses. The plant species which occurred at Station 1 might be because of partial contamination by human and cattle interference (washing, bathing etc.), and are considered to be moderately pollution-tolerant plants. In contrast, the plant communities which are present at Station 3 could be influenced by the inflow of fresh or clean water from Nav Talav which supplies drinking water to more than 35 villages. These could be considered as plants intolerant of pollution.

Hence the chemical status of the water appears to be the most vital factor, significantly influencing the general distribution of aquatic plants, but other abiotic factors such as bottom soil, physical nature of pond and fluctuations of temperature and water level greatly affected the distribution of plants within the range of chemical tolerance.

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